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INSTRUCTION NO. 7

TECHNICAL INFORMATION POTTING COMPOUNDS AND SEALANTS

BY

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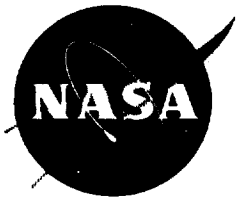

GODDARD SPACE FLIGHT CENTER
GREENBELT, MD.

April 11, 1962

TO: O.G.O. Experimenters

FROM: F.T. Martin

SUBJECT: Potting Compounds and Sealants for Spacecraft Applications

The inclosed instruction pamphlet is forwarded in response to a request from Mr. E.P. Mercanti, for Eccofoam and epoxy resin specifications for the general information of O.G.O. experimenters.

This instruction was prepared by Mr. Francis N. LeDoux, Head of the Structural and Mechanical Laboratory Section of this branch, to provide general guidance for technicians working in his lab. Although it does not cover the broad field of epoxy resins, I'm sure it will be of great assistance to you in your work.

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Incl.

1. INTRODUCTION

1.0.1 In the development of payloads for space applications it is required that many and varied resins, sealants and adhesives be used to achieve desired results.

The purposes of their use are also varied, however, in general the resins are used to effect light weight structural reinforcement of electronic components and associated wiring. The sealants are mainly used as moisture preventatives and pressure seals, however, they also serve as structural reinforcement.

This general instruction shall concern but a few of the resins and sealants used.

2.0.1 The following is a list of the potting compounds most commonly used in satellite component encapsulating applications at the GSFC.

1. Eccofoam FP, a foam in place liquid resin
2. PRC, a Thiokol liquid polymer compound
3. Stycast 2340M, a flexible expoxide casting resin
4. Locktite, a sealant

3.0 Material

Eccofoam FP is most generally used in void filling so as to obtain a light weight structural reinforcement of embedded electronic components.

3.0.1 Molds

In order to properly contain the Eccofoam potting compound a mold must be made. An example of such a mold is shown on page 9 sketch A. The molds used for potting the electronic modules are usually made of aluminum, however, this is not considered a requirement as many other metals would also be suitable.

3.0.2 Electronic Cards

The electronic cards that are to be potted should contain relief holes so as to allow a more even expansion of potting compound on both faces of the card. Where this is not possible it is recommended that a stand off be affixed to the card so as to prevent warping of card. The bottom face of the electronic card should have, if possible stand offs placed, (rule of thumb) approximately two inches apart from each other. Your attention is drawn to sketch B page 10 this instruction.

3.0.3 EXAMPLE

It is required that an electronic card be embedded in Eccofoam FP. It is also required that the density of foam be approximately 10 lbs./cu. ft. In order to fulfill these requirements the following procedure is recommended.

3.0.4 Determine volume of empty mold.

3.0.5 Determine approximate volume of electronic card being potted.

3.0.6 The difference between 3.0.4 and 3.0.5 is the required volume that is to be filled with foam.

3.0.7 The amount of potting compound that will be needed is found as follows:

a. Volume of mold 400 cc

b. Volume of electronic card to be potted 150 cc

c. Volume of foam required 250 cc

d. Desired density 10 lbs./cu. ft. (.16 gm/cc)

e. C X D equals the amount of foaming compound required to fill mold. (250 cc x .16 gm/cc) = 40 grams. A ten percent (10%) increase of this amount should be added so as to allow for waste. Therefore use 44 grams of resin and catalyst. The ratio of catalyst to 100 parts of resin should be 11, however, a ratio of 10 to 1 is adequate.

4.0 Procedure

4.0.1 Place electronics card in mold.

4.0.2 Determine the number and location of stand offs.

4.0.3 Make required number of stand offs and affix them to the electronics card.

4.0.4 Determine the areas that are to be left free of potting material i.e., plug connectors, rim pots or other adjustements.

4.0.5 Fabricate plugs needed to protect areas from potting compound. Teflon is an ideal material to use. Duxseal may also be used for this purpose if the area is not large.

4.0.6 Spray all inside surfaces of the mold with Teflon mold release.

4.0.7 Put silicone mold release on pin connectors even if they are covered with a Teflon plug.

4.0.8 Place electronic card, that is to be potted, into the mold.

4.0.9 Place all protective plugs and duxseal in areas required to be protected from potting compound.

NOTE

Before using Eccofoam FP heat contents in its container to 165°F then allow to cool; required once only. CAUTION provide adequate ventilation and stir constantly.

4.1.0 Weigh out required amount of Eccofoam liquid resin (3.0.7) into paper cup. Weigh out required amount of 12-6 catalyst (3.0.7).

a. Method used at the GSFC is to use a hypodermic syringe in weighing catalyst (1 cc = 1.1818 grams)

4.1.1 Place catalyst into cup that contains the Eccofoam liquid.

4.1.2 Mix rapidly using a drill motor and a special mixing blade as shown on sketch C page 11.

NOTE

Mix should be completed in less than a minute. Avoid fumes, work in ventilated area.

4.1.3 As quickly as possible distribute the Eccofoam mix as evenly as possible over the electronics card in the mold.

4.1.4 Place mold cover, that has previously been coated with spray mold release, upon the mold body.

4.1.5 Immediately place C-clamps in position around edge of mold and tighten finger tight. An example is shown on sketch D page 12.

4.1.6 Place mold into oven preheated to 150°F and allow to cure for approximately one and one half (1-1/2) hours at 150°F. Molds having greater volumes than 700cc and/or thicker walls than the mold as shown in sketch C page 11 should be allowed to remain in oven for a two hour cure. The converse is also true. If mold volume is less than 400 cc and thinner walls, cure may be obtained in approximately 1 hour at 150°F.

4.1.7 After cure has been completed allow mold to cool to room temperature before removal. If use time is critical rapid cooling can be obtained by placing entire mold and clamping assembly into a refrigerator.

4.1.8 Cut away excess potting material from mold.

4.1.9 Remove clamps and mold cover. A thin blade knife will aid in removal of the cover.

4.2.0 Apply, with fingers, a slight pressure around edges of potted card so as to remove card from mold.

4.2.1 Trim rough edges, remove protecrive plugs and duxseal.

NOTE

4.2.2 Conditions which affect density

4.2.3 Mold pre-heat

The higher the heat the lower the density.

4.2.4 Size of pour

The larger the amount of pour the lower the density.

4.2.5 Mold restraint

The less restraint the lower the density.

4.2.6 Humidity

The higher the relative humidity the lower the density.

4.2.7 Mold material and heat dissipation

The higher the rate of heat loss, the higher the density.

4.2.8 Standard conditions

In order to obtain a comparison of the anticipated densities when using the same catalyst and base material, but varying the condition of mold restraint, standard conditions of other factors were set up. These conditions were as follows:

a. Mold pre-heat (none) ambient temp. 75°F

b. Size of pour (approximately) 250 cc

c. Humidity (approximately) 30%

d. Mold material 6061-TG aluminum 1/4" thick wall (sketch D page 12).

4.2.9 EXAMPLE (1) Unrestrained, free expanding

With the above standard conditions prevailing (4.2.8) a 12-6 catalyst will activate the Eccofoam base to an approximate density of six (6) lbs. per cu. ft.

EXAMPLE (2) Restrained mold

With the above standard conditions prevailing (4.2.8) a 12-6 catalyst used in the proportions according to procedures 3.0.3 thru 3.0.7 would activate the Eccofoam base to an approximate density of ten (10) lbs. per cu. ft.

NOTE

Molds used at the GSFC do not completely confine the potting materials as the pressure relief holes (sketch B page 10) allow escape of small amounts of materials.

GENERAL INSTRUCTIONS FOR USE OF PRC COMPOUND

5.0 PRC compound is most generally used as a sealant against metallic particles and moisture, also as a prevention of wire fatigue under vibration.

In order to properly contain the sealant a mold must be used. An example of such a mold is shown on the attached sketch E page 13. It is recommended that the mold be made of Teflon as the sealant will not adhere to its sufraces.

5.0.1 The connector that is to be potted should be free of grease, oil or wax in order to insure good adhesion of the PRC. Cleaning may be accomplished with a small brush that has been dipped in acetone.

NOTE

Do not expose wire insulation and inserts to the acetone for any long period of time.

5.0.2 Separate the wires so as to allow a free flow of compound around all wires and soldered connections.

5.0.3 With a clean wood tongue depressor or putty knife stir the contents slowly until contents appear as a smooth creamy paste.

5.0.4 With a clean wood tongue depressor or putty knife stir the base compound until base material appears smooth.

NOTE

The ratio of base compound to accelerator is 10 to 1 by weight.

5.0.5 Weigh out required amount of accelerator in paper cup.

5.0.6 Weigh out the required amount of base compound in paper cup.

5.0.7 Put the accelerator into the cup containing base material and hand mix slowly with a clean wood tongue depressor or clean spatula. Mix for approximately 5 to 7 minutes. Frequently scrape spatula so as to remove unmixed compound.

5.0.8 Allow air cure for a minimum of 30 minutes.

5.0.9 Cure by means of heat lamp or drying oven when applicable.

NOTE

Do not cure over 130°F as compound may expand and cause the texture of the sealant to become porous.

NOTE

PRC cures to a tack free condition within twenty-four (24) hours if temperature is maintained at 77°F and the relative humidity at 50%. The effect of humidity is indicated by the fact that compound will become tack free 20 times as fast at 95% relative humidity.

General instructions for use of Stycast 2340M casting resin

5.1.0 Stycast resin is usually used as a pressure sealant. When used for this purpose it is used with PRC compound.

5.1.1 The connector should first be prepared as recommended in procedure 5.0.1. Procedures including pertinent notes from 5.0.1 thru 5.0.9 should be followed with the exception of amount of PRC and cure.

5.1.2 Weigh out amount of PRC and accelerator to cover the back of pin connectors and soldered joints.

5.1.3 Brush on the PRC. Only a thin coating is required as the purpose of the PRC is to prohibit the penetration of Stycast through insert and pin case.

NOTE

Always wash hands before eating or smoking. If accelerator contacts the skin, flush area with warm water.

5.1.4 After cure has been effected place Teflon mold around connector.

5.1.5 Separately weigh equal amounts of Stycast components A and B. Do not mix; leave each component part in its own container.

5.1.6 Heat components in oven at 125°F. Purpose of this procedure is to reduce the viscosity in order to facilitate mixing.

5.1.7 Using a clean spatula mix together compound parts A and B. Mix for approximately four (4) minutes. An even mix will have a brick red color without any gray streaks.

5.1.8 Cast into mold over wire and connector pins that were previously coated with PRC compound.

5.1.9 Cure overnight in oven at 150°F.

NOTE

Overnight cure is recommended if connector is to be subjected to pressure during use. If connector is not to be pressurized a fast cure of four (4) hours at 200°F is adequate.

GENERAL INSTRUCTIONS FOR USING LOCKTITE SEALANT

5.2.0 Locktite sealant is generally used on all critical fasteners at final assembly of payload structures. It is also used on threaded terminals on battery packs.

The primary purpose of using locktite is to enhance resistance of mechanical connection to vibration and eliminate loose electrical connections in service resulting in increased mechanical strength of circuit.

5.2.1 Screws to be locktited should be free of grease, oil or wax.

5.2.2 Place small amount of locktite into a small clean dish.

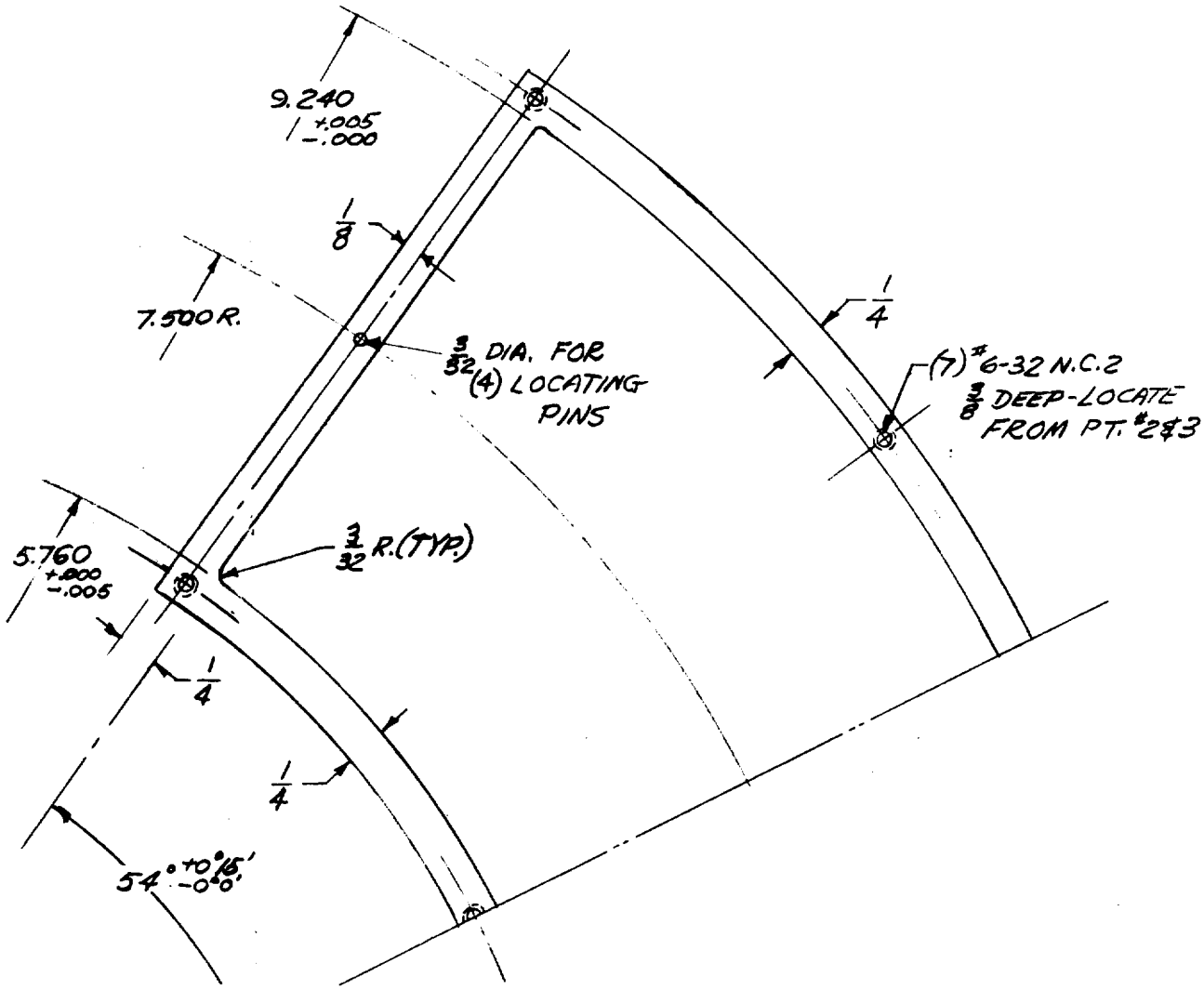
5.2.3 Apply locktite to screw thread with a small clean brush. Only a very small amount is required, i.e., a maximum of one drop on an average size screw (6-32).

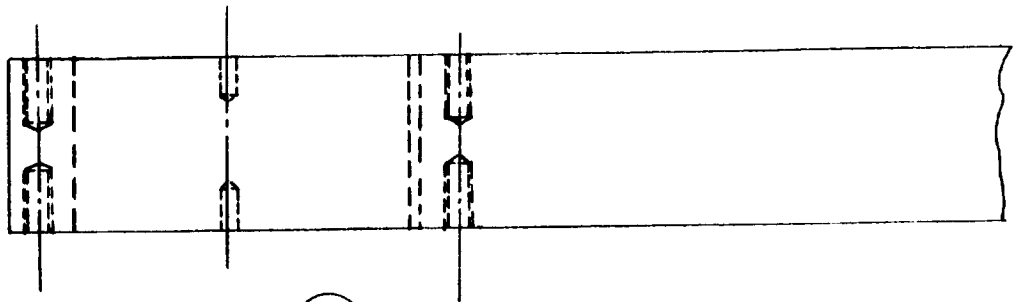
5.2.4 As an alternate method of application the screw that is to be locktited may be placed on a mechanical screw holder and dipped into the locktite in a dish. Again only a small amount is needed.

5.2.5 Screw the locktited screw into position at desired torque and allow to cure for approximately five (5) hours at 75°F before vibrating assembly.

NOTE

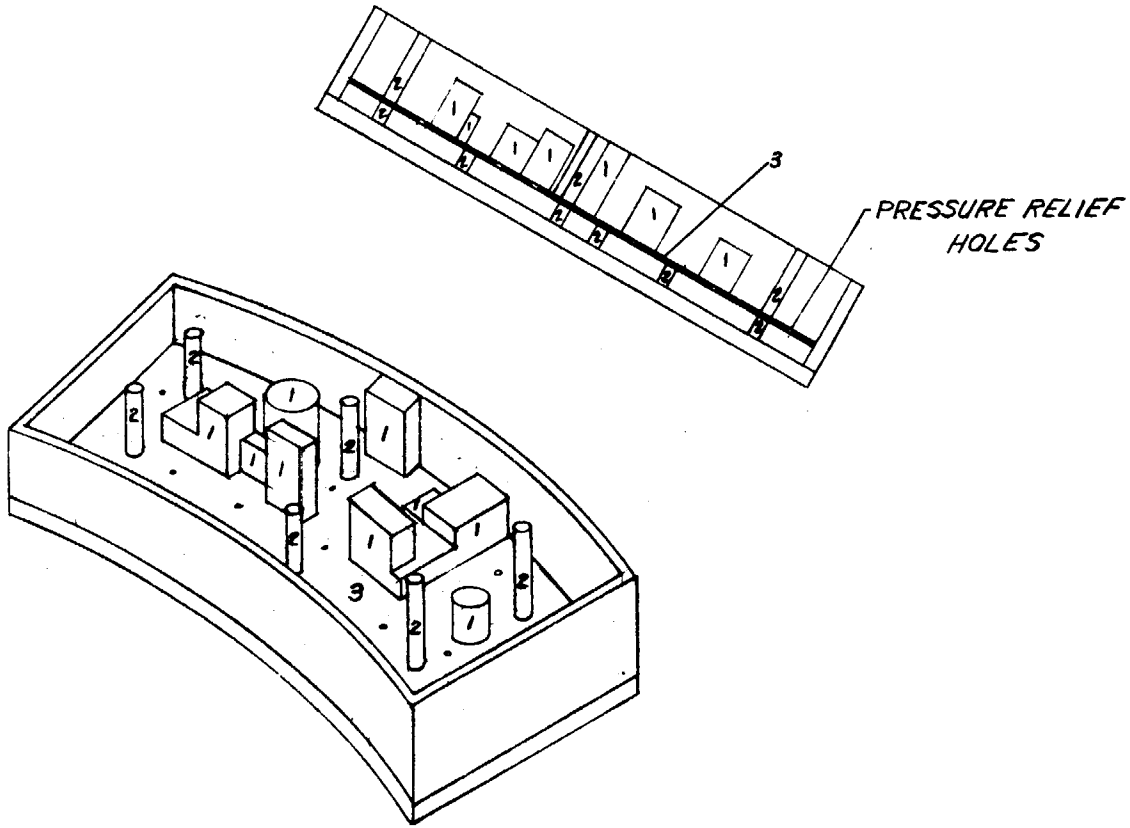
Locktite C and CV are the most generally used grades at the GSFC in the assemblies of aluminum and/or magnesium.



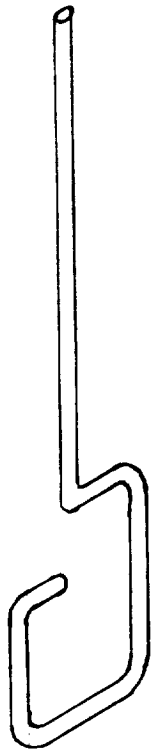


(1) FRAME, POTTING MOLD
MAT'L - 6061-T6 ALUMINUM

SKETCH A


3
PRESSURE RELIEF HOLES
1 ELECTRONICS COMPONENTS
2 STAND-OFFS
3 PRINTED CIRCUIT CARD

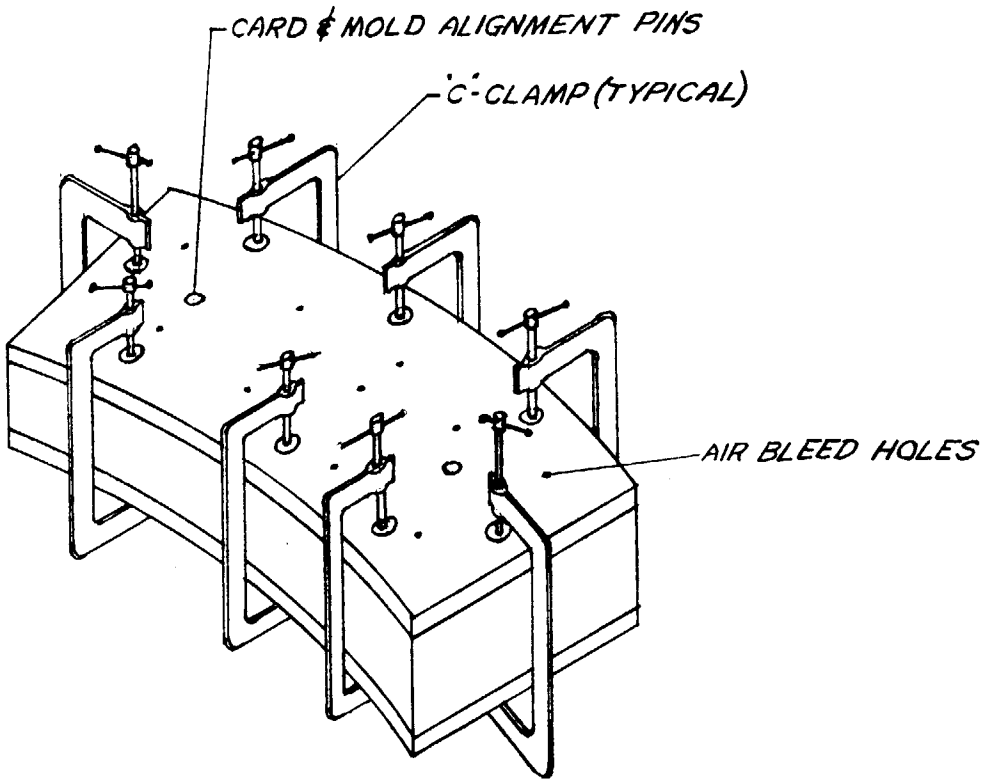
SKETCH B



POTTING MIXER

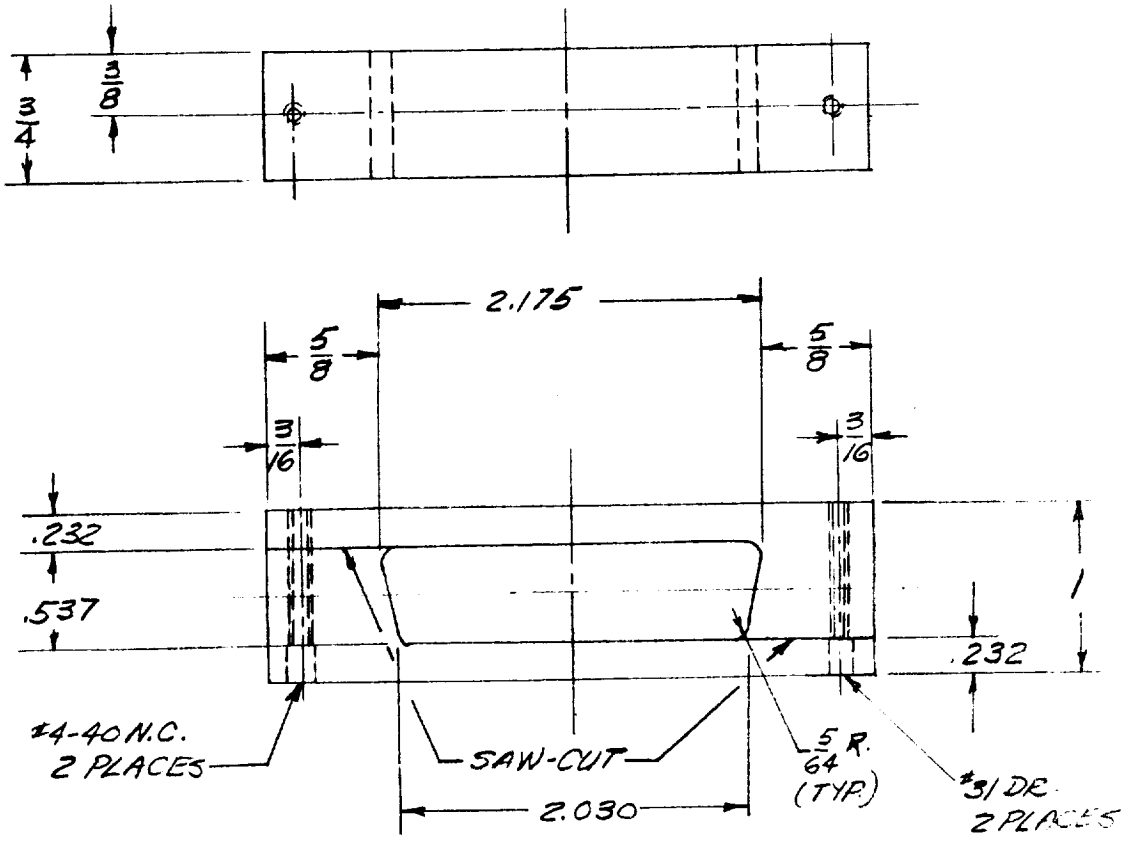
SKETCH C

11..



SKETCH D

NOTE
1. 63/ MACHINE FINISH
2. FOR 50 PIN PLUG



POTTING MOLD, CANNON PLUG
MAT'L - TEFLON

SKETCH E